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CORRECTION #2

April 10, 1995

Grain Dust Explosions Up in 1994*

There were 15 grain dust explosions reported for the U.S. in 1994 according to Robert W. Schoeff, Professor Emeritus and Consultant, Kansas State University and Ralph Regan, Safety Director, USDA-FGIS. This compares to 13 in 1993 and a ten-year average of 15 explosions.

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Seven of the fifteen incidents occurred in grain elevators, three in flour mills, and one in a wet corn milling and malt plant.

The bucket elevator (leg) continues as the leading location for the primary explosion, 9 of 15.

The **probable cause** of ignition was bearing failure (3), sparks in grinder (3), welding and cutting (2), fire from burning belt, hot metal surface and unknown (5).

Fuel sources were identified as corn (8), wheat (2), rice, sorghum, oat hulls, barley malt and protein supplement pellets.

Most of the grain dust explosions occurred in the midwest with four in Iowa, three in Kansas, and one in Arkansas, Illinois, Indiana, Minnesota, Nebraska, North Carolina, Oregon, and Pennsylvania. Dust explosions have occurred in 25 states during the past ten years with Iowa the leading state with 21 reported explosions.

Property damage was estimated to be \$7,228,000.00.

Appreciation is expressed to the many persons who provided the information that allowed us to compile data on grain dust explosions as a service to the grain storage and processing and allied industries, trade associations, and government agencies.

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*This report subject to revision as additional information is received.

| REPORTED GRAIN DUST EXPLOSIONS IN U.S. - 1994** | | | | | | |
|---|-------------|---|---------------------|----------------|---------------|----------------|
| <u>NO.</u> | <u>DATE</u> | <u>COMPANY AND ADDRESS</u> | <u>FACILITY</u> | <u>DAMAGE*</u> | <u>KILLED</u> | <u>INJURED</u> |
| 1 | Jan. 11 | ADM Milling Co. Mt. Vernon, IN | Flour Mill | Moderate | 0 | 0 |
| 2 | Feb. 20 | Farmers Co-op Lawrence, KS | Grain Elevator | Minor | 0 | 1 |
| 3 | Apr. 14 | Grant Co. Feeders Ulysses, KS | Feed Mill | Minor | 0 | 4 |
| 4 | Apr. 18 | ADM Co. ¹ Peoria, IL | Grain Elevator | Moderate | 0 | 2 |
| 5 | Apr. 21 | Roush Products Co. Cedar Rapids, IA | Bakery Mix Plant | Moderate | 0 | 0 |
| 6 | May 2 | Spanglers Flour Mills Mt. Joy, PA | Flour Mill | Moderate | 0 | 0 |
| 7 | May 28 | Penford Products Cedar Rapids, IA | Starch Plant | Moderate | 0 | 0 |
| 8 | June 16 | Rahr Malting Co. Shakopee, MN | Malt Plant | Severe | 0 | 2 |
| 9 | July 22 | Kroft Feed Inc. Harrisburg, OR | Feed Mill | Severe | 0 | 4 |
| 10 | Aug. 25 | Fort Kearny Feeders Minden, NE | Feed Mill | Minor | 0 | 0 |
| 11 | Sept. 14 | Riceland Foods Jonesboro, AR | Grain Elevator | Minor | 0 | 0 |
| 12 | Sept. 25 | Tama-Benton Co-op Dysart, IA | Grain Elevator | Moderate | 0 | 0 |
| 13 | Oct. 30 | Consolidated Co-op Gowrie, IA | Grain Elevator | Moderate | 1 | 1 |
| 14 | Nov. 23 | Healy Co-op Healy, KS | Grain Elevator | Moderate | 0 | 0 |
| 15 | Dec. 26 | W.L. Pryor Feed & Farm Supply Ruffin, NC | Grain Elevator | Moderate | 0 | 0 |
| | | | | TOTALS | <u>1</u> | <u>14</u> |

*Minor: Less than \$50,000; Moderate: \$50,000-\$500,000; Severe: Over \$500,000

¹Company will not cooperate in providing basic information.

**Report is subject to revision as new information is received.

In cooperation with Ralph Regan, FGIS, USDA, Washington, DC

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April 10, 1995

TABLE 1. U.S. GRAIN DUST EXPLOSION STATISTICS*

| | <u>1985</u> | <u>1986</u> | <u>1987</u> | <u>1988</u> | <u>1989</u> | <u>1990</u> | <u>1991</u> | <u>1992</u> | <u>1993</u> | <u>1994</u> | <u>TEN YEAR TOTAL</u> |
|--------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|---------------------------|
| Number | 23 | 23 | 16 | 12 | 13 | 15 | 12 | 6 | 13 | 15 | 148 |
| Dead | 4 | 2 | 0 | 8 | 2 | 0 | 1 | 1 | 2 | 1 | 21 |
| Injured | 20 | 14 | 18 | 10 | 7 | 7 | 4 | 8 | 20 | 14 | 122 |
| Est. Damage to Facility (\$ Mil.) | 65.0 | 1.6 | 8.3 | 8.7 | 3.9 | 5.0 | .3 | .4 | 4.0 | 7.1 | 104.3 |
| Type of Facility: | | | | | | | | | | | |
| Grain Elevator | 19 | 13 | 11 | 7 | 7 | 8 | 4 | 5 | 9 | 7 | 90 |
| Feed Mill | 1 | 5 | 4 | 1 | 1 | 1 | 4 | 0 | 0 | 3 | 20 |
| Flour Mill | 0 | 1 | 0 | 0 | 0 | 2 | 1 | 0 | 1 | 2 | 7 |
| Other: | | | | | | | | | | | |
| Corn Milling, Dry | 2 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 6 |
| Corn Milling, Wet | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 1 | 1 | 5 |
| Soybean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rice Mill | 1 | 2 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 6 |
| Oat Mill | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Other | 0 | 2 | 1 | 0 | 2 | 1 | 2 | 1 | 2 | 2 | 13 |

*Source: Robert W. Schoeff, Kansas State University, in cooperation with Ralph Regan, FGIS-USDA, April 10, 1995

TABLE 2. GRAIN DUST EXPLOSIONS
BY COMMODITY HANDLED AT TIME OF EXPLOSION

| <u>COMMODITY</u> | <u>1985</u> | <u>1986</u> | <u>1987</u> | <u>1988</u> | <u>1989</u> | <u>1990</u> | <u>1991</u> | <u>1992</u> | <u>1993</u> | <u>1994</u> | <u>TEN YEAR TOTAL</u> |
|-------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------------------------|
| Corn | 14 | 6 | 13 | 7 | 4 | 2 | 5 | 4 | 9 | 8 | 72 |
| Sorghum | 2 | 6 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 1 | 12 |
| Soybeans | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 6 |
| Wheat | 0 | 2 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 2 | 9 |
| Barley | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 5 |
| Oats | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 4 |
| Beet Pulp | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Corn Starch | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 2 | 0 | 5 |
| Corn Gluten Meal | 2 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 4 |
| Distillers Feed | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Feed By-Products | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| Grain Screenings | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 |
| Mixed Feed | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Rice (Bran)(Flour) | 1 | 2 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 6 |
| Wheat Flour | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Wheat (Starch) (Gluten) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Other | 2 | 5 | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 1 | 16 |
| TOTAL EXPLOSIONS | 23 | 23 | 16 | 12 | 13 | 15 | 12 | 6 | 13 | 15 | 148 |

Source: Robert W. Schoeff, Kansas State University, Manhattan, KS 66506-2201, April 10, 1995

TABLE 3. U.S. GRAIN DUST EXPLOSIONS

LEADING STATES - 1958 to Date

| <u>STATE</u> | <u>1958- 1984</u> | <u>1985</u> | <u>1986</u> | <u>1987</u> | <u>1988</u> | <u>1989</u> | <u>1990</u> | <u>1991</u> | <u>1992</u> | <u>1993</u> | <u>1994</u> | <u>10-YEAR TOTAL</u> |
|--------------|-----------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------------------|
| Iowa | 41 | 2 | 2 | 2 | 1 | 3 | 0 | 4 | 2 | 1 | 4 | 21 |
| Kansas | 21 | 1 | 6 | 0 | 0 | 3 | 3 | 1 | 0 | 0 | 3 | 17 |
| Illinois | 41 | 4 | 1 | 2 | 1 | 2 | 2 | 0 | 1 | 0 | 1 | 14 |
| Minnesota | 29 | 2 | 1 | 1 | 3 | 1 | 2 | 0 | 0 | 1 | 1 | 12 |
| Nebraska | 52 | 4 | 2 | 0 | 0 | 1 | 0 | 1 | 0 | 3 | 1 | 12 |
| Indiana | 13 | 2 | 1 | 2 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 9 |
| Louisiana | 8 | 0 | 2 | 0 | 1 | 2 | 2 | 0 | 0 | 2 | 0 | 9 |
| Ohio | 17 | 2 | 0 | 2 | 0 | 0 | 1 | 1 | 0 | 2 | 0 | 8 |
| Texas | 34 | 1 | 2 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 7 |
| Missouri | 23 | 0 | 1 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 4 |
| South Dakota | 4 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 |
| Washington | 2 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 4 |

Source: Robert W. Schoeff, Kansas State University, Manhattan, KS 66506-2201, April 10, 1995